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AUTHOR Machiels-Bongaerts, Maureen; And Others
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ABSTRACT

The effects of mobilizing prior knowledge on information processing were studied. Two hypotheses, the cognitive set-point hypothesis and the selective attention hypothesis, try to account for the facilitation effects of prior knowledge activation. These hypotheses predict different recall patterns as a result of mobilizing prior knowledge. In experiments supporting these hypotheses, different activation strategies have been applied, resulting in different ways of information processing. The assumption was tested by providing two groups of subjects with different reading goals that would lead to the results predicted by the two hypotheses. Study time allocated to different parts of the study material and free recall were registered for two groups of six subjects (a problem group that mobilized information about the consequences of fishery policies and a tourism group that mobilized knowledge that could be important for a tour operator who had to select new holiday locations) and a control group of six that mobilized knowledge concerning a neutral topic (tennis). Results show that mobilizing prior knowledge can result in different patterns of recall and study time allocation, which supports the assumption that both hypotheses can provide valid explanations for the facilitation effects of prior knowledge activation. Two tables present study data. (Author/SLD)

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# The Effects of Prior Knowledge Activation on Free Recall and Study Time Allocation

Maureen Machiels-Bongaerts, Henk G. Schmidt,
and Henny P.A. Boshuizen
University of Limburg, Maastricht, The Netherlands

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Abstract

Effects of mobilizing prior knowledge on information processing were studied. Two hypotheses, the cognitive set-point hypotheses and the selective attention hypothesis, try to account for the facilitation effects of prior knowledge activation. These hypotheses predict different recall patterns as a result of mobilizing prior knowledge. However, in experiments supporting these hypotheses, different activation strategies were applied, resulting in different ways of information processing. This assumption was tested by providing two groups of subjects different reading goals, which would lead to the results predicted by the two hypotheses. The study time, allocated to different parts of the study material and free recall were registered for these two groups and a control group. The results show that mobilizing prior knowledge can result in different patterns of recall and study time allocation, which supports the assumption that both hypotheses can provide valid explanations for the facilitation effects of prior knowledge activation.

# The Effects of Prior Knowledge Activation on Free Recall and Study Time Allocation

What you already know, determines to a great extent what you can learn (Anderson, 1977, 1978). Indeed, a number of studies have shown that prior knowledge activation facilitates subsequent information processing. However, a satisfying explanation for this phenomenon is yet to be found. Various hypotheses try to account for these facilitation effects, but they predict different recall patterns as a result of prior knowledge activation.

The selective attention hypothesis, for instance, predicts as a result of prior knowledge activation that information activated is better recalled than non-activated information (Reynolds, Standiford, & Anderson, 1979; Reynolds & Anderson, 1982). According to the selective attention hypothesis, the reader selectively pays attention to information relevant to the prior knowledge activated, which is therefore better remembered (Goetz, Schallert, Reynolds, & Radin, 1983; Pichert & Anderson, 1977).

The predictions of an alternative explanation for the facilitation effects, the cognitive set-point hypothesis, are diametrically opposed to those of the selective attention hypothesis. The cognitive set-point hypothesis predicts that prior knowledge activation leads to overall better recall. According to the cognitive set-point hypothesis, a cognitive set-point is applied during text processing, indicating when enough capacity has been spent on processing certain information. This cognitive set-point could be reached sooner as a result of prior knowledge activation since during the activation phase the processing of this information has already started. During subsequent text

processing, relatively little cognitive capacity is required to reach the cognitive set-point for information corresponding to the information previously activated. Consequently, when an experimental group and a control group have the disposal of the same amount of time to process a text, the experimental group can process more information than the control group in the same amount of time as a result of prior knowledge activation (Schmidt, 1982). The experimental group requires little cognitive capacity - and time - to process information activated. Therefore, the experimental group remains more capacity and more time to study non-activated information than the control group. Thus, as a result of prior knowledge activation the experimental group was expected to show a shift in attention from information activated to non-activated information. Therefore, the experimental group would show overall higher recall scores than the control group (Peeck, 1982; Peeck, Van den Bosch, & Kreupeling, 1982).

After a closer scrutiny of the studies supporting these conflicting hypotheses, Machiels-Bongaerts, Schmidt, and Boshuizen (1990) suggested that both hypotheses could be valid under certain conditions. They suggested that researchers had instilled different kinds of reading goals in their subjects by means of different activation strategies. This could have led to different ways of text processing, resulting in different recall patterns.

In experiments providing support for the selective attention hypothesis (Goetz et al., 1983; Pichert & Anderson, 1977) prior knowledge was activated by assigning subjects a specific perspective from which the text should be read. This activation technique would lead to a very specific reading goal: Selecting information only relevant

to the slots of an activated schema. During text processing, attention would be paid to text elements that corresponded with the activated schema. Everything else, irrespective of its importance in the text itself, would be ignored and therefore be forgotten.

By contrast, in experiments providing evidence for the cognitive set-point hypothesis, prior knowledge was activated by means of mobilization; that is, subjects were encouraged to bring to mind certain information (Peeck, 1982; Peeck et al. 1982). By means of this activation strategy, a general reading goal was instilled: Learning, extending the knowledge activated. Subjects who activated prior knowledge could focus on important, non-activated information. By integrating this new information into the knowledge activated, this knowledge could be extended. In other words, the subjects learned something new. Thus, as a result of prior knowledge activation a shift in attention from information activated to non-activated information would occur.

Machiels-Bongaerts et al. (1990) tested the assumption that both hypotheses could be valid, depending on the reading goal and reading strategy applied. Two groups of subjects were provided with two different reading goals. These groups read the same text, describing the consequences of the E.E.C. fishery policies for a small (non-existing) coastal village in Portugal.

One group of subjects was asked to mobilize knowledge with respect to the E.E.C. fishery policies. This task was expected to instill a general reading goal during subsequent text processing. The knowledge activated corresponded with an important part of the text, in which the problem the villagers had to face (i.e., the consequences of the E.E.C. fishery policies) was described. It was assumed that this

information required little cognitive capacity during text processing. Relatively more cognitive capacity remained available for processing non-activated information, increasing the possibility that for this information the cognitive set-point could be reached as well. The knowledge activated could be extended by integrating non-activated information. Therefore, the recall pattern of this so-called 'problem group' was expected to reflect the predictions of the cognitive set-point hypothesis.

The second group of subjects was requested to mobilize information that was important for a tour operator who had to select new holiday locations. This task was expected to result in the activation of a 'holiday' schema. The slots of this schema could be filled with text elements rather redundant in the text itself, providing specific information about the village in Portugal. During text processing, this group was expected to constantly select text elements that filled the slots of the schema, skipping everything else. The recall pattern of this so-called 'tourism group' would reflect the predictions of the selective attention hypothesis since only information matching the slots of the schema activated would be recalled.

While reading, each subject had to mark all text elements that were important with respect to their instruction. After a twenty minutes delay, subjects were requested to recall orally everything they could remember from the text. The problem group mainly marked information corresponding with the problem of the text, whereas the tourism group mainly marked information that filled the slots of the schema activated, which indicates that the instructions were effective. Recall protocols of the problem group indicated that during text processing a shift from information activated to important, non-acti-

vated information had occured. This increase in recall of new, non-activated information did not result in an impairment of recall of activated information, compared to the mean number of propositions marked during reading. On the other hand, the tourism group did not show a large increase in recall compared to the number of propositions marked during reading; this group focused on text elements that fitted into the schema activated.

These results indicate the validity of the assumption of Machiels-Bongaerts et al. (1990). However, the paradigm applied, marking relevant text elements during reading, was considered to be a rather poor operationalization to measure on-line behavior. Therefore, in a follow-up study, reported in this article, study times for each sentence of the text were registered. Through this paradigm, the predictions derived from the two conflicting hypotheses could be examined more closely. In this study, three groups of subjects participated: (a) A problem group, who was provided with a general reading goal; (b) a tourism group, who was given a specific reading goal; and (c) a control group. Each subject had the disposal of the same amount of time to process the text about the consequences of the E.E.C. fishery policies once. Subjects could freely allocate totally available study time to each of the 57 sentences.

From the assumptions of the cognitive set-point hypothesis it can be deduced that reading time is an important variable. As a result of prior knowledge activation, certain information is partly processed already. During text processing, this information requires little capacity - and, hence, time - to reach the cognitive set-point. Since totally available study time is equal for the problem group and the control group, the problem group remains relatively more time to process

non-activated information, resulting in better recall performances for this information than the control group. Therefore, the problem group, who was provided with a general reading goal, was expected to show a shift in attention from information activated to non-activated information. More study time would be paid to non-activated information in order to reach cognitve set-point for this information type. Relatively less time would be required to reach the set-point for activated information. This pattern of study time allocation would result in overall higher recall scores of the problem group than the control group. These results would provide support for the cognitive set-point hypothesis.

The tourism group was expected to apply a specific reading goal during text processing: Selecting information, matching the slots of the schema activated. This group would spend more time on processing information corresponding with the schema than on studying other information types. Information activated would therefore be recalled better, which would support the selective attention hypothesis.

## Method

### Subjects

In this study three groups of six subjects participated: (a) The problem group, mobilizing knowledge that corresponded with the core of the text in which the consequences of the E.E.C. fishery policies were described ('problem information'); (b) the tourism group, mobilizing knowledge that could be important for a tour operator who had to select new holiday locations; and (c) the control group, mobilizing knowledge with respect to a neutral topic (tennis).

Material

The text contained three different information types, each consisting of 22 propositions and ten sentences, which were equal in length: (a) Problem information, in which the consequences of the E.E.C. fishery policies were described; (b) solution information, in which a solution for the forementioned problem was provided; (c) tourism information, which provided specific information about the village ("couleur locale"). To build a coherent text, 27 filler sentences were added ('residual information').

Procedure

During the mobilization phase, the problem group was explicitly asked to generate all their knowledge of the consequences of the E.E.C. fishery policies. The tourism group was asked to generate everything that would be important for a tour operator who had to select new holiday locations. The control group was asked to generate everything they knew about tennis.

During the study phase, the sentences of the text were presented one by one on a computer screen. Total study time available was 8'30", which could freely be distributed over the 57 sentences of the text. New sentences were presented on screen by pushing a button. During the study phase, the screen also provided information on how much time was left of the total study time.

After a twenty minutes delay, in which subjects had to answer in writing a number of difficult (medical) questions, subjects were requested to recall orally everything they could remember from the text.

Analysis

Study times for each sentence were registered. The reading text was divided into propositions, using a technique developed by Meyer

(1975). The recall protocols were transcribed. For each subject the number of propositions correctly recalled was calculated for each information type.

## Results and Conclusions

By means of one activation strategy, mobilizing prior knowledge, two different reading goals were instilled. The patterns of recall and allocation of study time of the problem group were expected to reflect the predictions of the cognitive set-point hypothesis, whereas those of the tourism group would correspond with the predictions of the selective attention hypothesis.

The problem group was expected to pay less time to process problem information since during the mobilization phase this information was already paid attention to. Compared to the control group, the problem group would require less study time to reach the cognitive set-point of this information type. Therefore, the problem group could shift earlier to non-activated solution information. In the same amount of study time, the problem group could process more information parts, which would result in overall higher recall scores.

The tourism group would focus on selecting information filling the slots of the activated schema. Therefore, study time would largely be paid to tourism information that was rather unimportant in the text itself. The other information parts, irrespective of their importance in the text itself, would largely be ignored since they did not correspond to the schema. This very specific reading goal would therefore result in better recall of slot-filling tourism information.

Table 1 shows the average study times of the three groups of subjects for each information type.

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Insert Table 1 about here

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The three groups differed in study time used ($F(2, 15) = 5.77$, $p < .05$). The tourism group did not fully use the available study time to select information. This group spent more time on processing tourism information than on studying the other information types. This pattern shows that the tourism group applied a specific reading goal: Selecting matching information, which supports the selective attention hypothesis.

The problem group and the control group used the same amount of study time ($F(1, 10) < 1$), but they differed in the way this time was distributed over the four information types ($F(3, 30) = 14.926$, $p < .0001$). As predicted by the cognitive set-point hypothesis, the problem group spent less time on studying information activated (problem information) than on processing important, non-activated (solution) information ($t(5) = 4.614$, $p < .01$). Since the problem information was not previously activated by the control group, who could not benefit from prior knowledge activation, this group had to spend more time processing problem information than the problem group ($F(1, 11) = 8.886$, $p < .05$). Therefore, the problem group could spend more time on processing solution information than the control group ($F(1, 11) = 5.858$, $p < .05$), which could be deduced from the predictions of the cognitive set-point hypothesis.

Table 2 contains the mean number of propositions, correctly recalled for the three groups.

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Insert Table 2 about here

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The three groups differed in the total number of propositions correctly recalled ($F(2, 15) = 8.448$, $p < .01$). The tourism group mainly recalled tourism information, which confirms the recall predictions of the selective attention hypothesis.

As predicted by the cognitive set-point hypothesis, the overall recall performances of the problem group exceeded those of the control group, but this effect failed to reach significance ($F(1, 11) = 3.218$, $p = .10$). These groups did differ in recall of the four information types ($F(3, 30) = 4.783$, $p < .01$). The problem group recalled more non-activated important (solution) information than the control group ($F(1,11) = 6.411$, $p < .05$). This recall pattern could appear since the problem group had relatively more time to process solution information as a result of prior knowledge activation. Yet, the recall scores of the problem group with respect to information activated (problem information) was not impaired, since these scores were equal to those of the control group ($F(1, 11) < 1$). Thus, the recall pattern of the problem group largely reflects the predictions of the cognitive set-point hypothesis.

These results indicate that both the selective attention hypothesis and the cognitive set-point hypothesis may account for facilitative effects of prior knowledge activation. These findings further support the assumptions of Machiels-Bongaerts et al. (1990). The differences

in recall patterns, predicted by these hypotheses, resulted from different reading goals and reading strategies, which was demonstrated by the way in which study time was distributed. The tourism group, who was expected to reflect the predictions of the selective attention hypothesis, applied a specific reading goal: Selecting information matching the activated schema. During text processing, attention was selectively paid to this information, ignoring everything else. This led to the recall patterns as predicted by the selective attention hypothesis: Information activated was recalled better than non-activated information. The problem group applied a general reading goal during text processing: Extending the knowledge activated. This group was expected to benefit from prior knowledge activation. Due to prior knowledge activation, little capacity was required to process information activated. Compared to the control group, relatively more capacity and time remained to process new, non-activated information, resulting in the recall pattern as predicted by the cognitive set-point hypothesis. The recall scores of the experimental group exceeded those of the control group, which could be attributed to better recall of non-activated information. In other words, as a result of prior knowledge activation the experimental group has learnt more new, important information than the control group.

Other manipulations of available study time could provide more support for the assumption that both the selective attention hypothesis and the cognitive set-point hypothesis are valid explanations for the facilitation effects of prior knowledge activation. From these two hypotheses different predictions with respect to patterns of recall and study time allocation can be made when totally available study time is either totally free or totally fixed.

References

Anderson, R.C. (1977). The notion of schemata and the educational enterprise: General discussion of the conference. In R.C. Anderson, R.J. Spiro, & W.E. Montague (Eds.), Schooling and the Acquisition of Knowledge. (pp. 415 - 431). Hillsdale, NJ: Erlbaum.

Anderson, R.C. (1978). Schema-directed processes in language comprehension. In A. Lesgold, J. Pellegrino, S. Fokkema, & R. Glaser (Eds.), Cognitive Psychology and Instruction. (pp. 67 - 82). New York: Plenum Press.

Goetz, E.T., Schallert, D.L., Reynolds, R.E., & Radin, D.I. (1983). Reading in perspective: What real cops and pretend burglars look for in a story. Journal of Educational Psychology, 75, 4, 500 - 510.

Machiels-Bongaerts, M., Schmidt, H.G., & Boshuizen, H.P.A. (1990, April). The Effect of Prior Knowledge Activation on Text Recall: An Investigation of Two Conflicting Hypotheses. Paper presented at the meeting of the American Educational Research Association, Boston, MA.

Meyer, B.J.F. (1975). The Organization of Prose and Its Effect on Memory. Amsterdam: North-Holland.

Peeck, J. (1982). Effects of mobilization of prior knowledge on free recall. Journal of Experimental Psychology: Learning, Memory, and Cognition, 8, 6, 608 - 612.

Peeck, J., Van den Bosch, A.B., & Kreupeling, W.J. (1982). The effect of mobilizing prior knowledge on learning from text. Journal of Educational Psychology, 74, 5, 771 - 777.

Pichert, J.W. & Anderson, R.C. (1977). Taking different perspectives on a story. Journal of Educational Psychology, 69, 4, 309 - 315.

Reynolds, R.E. & Anderson, R.C. (1982). Influence of questions on the allocation of attention during reading. Journal of Educational Psychology, 74, 4, 623 - 632.

Reynolds, R.E., Standiford, S.N., & Anderson, R.C. (1979). Distribution of reading time when questions are asked about a restricted category of text information. Journal of Educational Psychology, 71, 2, 183 - 190.

Schmidt, H.G. (1982). Activation and restructuring of prior knowledge and their effects on text processing. In: A. Flammer & W. Kintsch (Eds.), Discourse Processing, (pp. 325 - 338). Amsterdam: North-Holland.

## Author Notes

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Requests for reprints should be sent to M. Machiels-Bongaerts, University of Limburg, Department of Educational Research and Educational Development, P.O. Box 616, 6200 MD Maastricht, The Netherlands.

Table 1

Average reading times in sec. of the three groups for each information type (= 10 sentences)

| | Information type | | | | |
|---|---|---|---|---|---|
| | Problem | Solution | Tourism | Residual [a)] | Total |
| Problem group | 93.022 | 113.665 | 65.495 | 68.620 | 340.802 |
| Tourism group | 54.320 | 61.215 | 109.510 | 59.220 | 284.265 |
| Control group | 117.790 | 90.078 | 64.910 | 77.668 | 350.446 |

Note. The residual information consisted of 27 sentences. To enable comparisons between the four information types, the study times for the residual information were transformed to time needed to study ten sentences.

Table 2

Mean number of propositions, correctly recalled by three groups of subjects for each information type (maximum = 22)

| | Information type | | | | |
|---|---|---|---|---|---|
| | Problem | Solution | Tourism | Residual [a)] | Total |
| Problem group | 12.167 | 14.500 | 3.000 | 8.500 | 38.167 |
| Tourism group | 2.083 | 3.500 | 10.917 | 4.667 | 21.167 |
| Control group | 12.917 | 9.167 | 2.417 | 7.000 | 31.500 |

Note. The residual information consisted of 34 propositions. To enable comparisons between the four information types, the recall scores for the residual information were transformed to a scale with a minimum of 0 and a maximum of 22.